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IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF CALIFORNIA

NETCHOICE, Plaintiff, **v.** **ROB BONTA, in his official capacity as Attorney General of California,** Defendant.	5:24-cv-07885-EJD **DECLARATION OF KENNETH A. FEDER, PH.D., IN SUPPORT OF DEFENDANT'S OPPOSITION TO PLAINTIFF'S MOTION FOR PRELIMINARY INJUNCTION** Date: December 17, 2024 Time: 9 a.m. Courtroom: 4, 5th Floor Judge: Honorable Edward J. Davila Trial Date: None Set Action Filed: November 12, 2024

DECLARATION OF KENNETH A. FEDER, PH.D.

I, Kenneth A. Feder, declare and state as follows:

1. I submit this declaration in support of Defendant's Opposition to Plaintiff's Motion for Preliminary Injunction.

BACKGROUND & QUALIFICATIONS

2. In 2019, I received a PhD from the Johns Hopkins Bloomberg School of Public Health, Department of Mental Health. In 2012, I received a BA from Wesleyan University with a double major in Physics and Psychology.

3. I am an epidemiologist with expertise in the causes, prevention, treatment, and amelioration of behavioral health conditions. In this capacity, I have conducted research on the relationship between adolescent social media use and behavioral health conditions. In particular, my peer reviewed article "Association between time spent using social media and internalizing and externalizing problems among adolescents" published in JAMA Psychiatry[1] has, according to Google Scholar, been cited more than 400 times (as of November 18, 2024), including by the U.S. Surgeon General's 2023 Advisory "Social Media and Youth Mental Health."

4. I also have conducted public health and population health research focused on adolescent mental health more broadly. In addition to my work on child and adolescent mental health, I conduct research on the epidemiology of substance use disorders such as opioid use disorder, which are closely related to the science of addiction. My research has been published in leading peer reviewed journals such as JAMA Psychiatry, Pediatrics, Health Affairs, American Journal of Epidemiology, Journal of Adolescent Health, and Journal of Substance Use and Addiction Treatment.

5. I am on the faculty of the Johns Hopkins Bloomberg School of Public Health, where I serve as an Assistant Research Professor in the Department of Mental Health. I lead an

[1] Riehm KE, Feder KA, Tormohlen KN, Crum RM, Young AS, Green KM, et al. Associations Between Time Spent Using Social Media and Internalizing and Externalizing Problems Among US Youth. JAMA psychiatry. 2019;1–9.

independent research portfolio focused on social and environmental risk factors for mental health and substance use disorders. Much of my research is focused on evaluating policies and programs intended to prevent behavioral health conditions, such as mental health or substance use disorders, and their associated harms, such as overdose or HIV infection. In addition to my research, I teach a doctoral level course on statistics for psychosocial research, which covers advanced statistical methods used for the measurement and analysis of psychological states and conditions such as depression or cognitive decline.

6. My *curriculum vitae*, which sets forth my experience and credentials more fully, is attached as Exhibit A.

7. I am being compensated in the above-entitled case at an hourly rate of $350/hour for preparing this declaration. My compensation is not in any way dependent on the outcome of this or any related proceeding.

8. I have been asked by the Office of the Attorney General to provide an opinion on the relationship between social media and adolescent mental and behavioral health, and on whether there is a scientific basis for believing that California's Protecting Our Kids from Social Media Addiction Act ("the Act:" or SB 976) may help protect children from negative mental and behavioral health outcomes.

9. The opinions in this declaration are my expert opinions, which are based on my expertise in the epidemiology of mental and behavioral health conditions. To prepare this report, I draw on my own research examining the relationship between time spent on social media and subsequent mental and behavioral health outcomes in adolescents, as well as other relevant recent studies and research on social media and mental health. I use this review of research to support my opinions and conclusions in this declaration.

10. If called to testify, I could and would testify competently to the truth of the matters discussed in this declaration.

OPINIONS

11. Based on my knowledge and review of the relevant literature, I reach the following conclusions:

12. First, there is a substantial and growing body of scientific research, including my own, showing that children and youth who spend more time on social media tend to experience worse mental health outcomes across multiple domains of mental health.

13. Second, multiple randomized trials across different age groups and settings have found that temporarily limiting or restricting access to social media improves subjective wellbeing, improves self-image and body image, reduces depression and anxiety symptoms, improves sleep quality, and reduces social media use over the long term.

14. Third, there are multiple plausible explanations for why spending more time on social media may negatively affect adolescent mental and behavioral health. These include disrupting sleep; fostering negative self-image by creating a forum where youth compare themselves to idealized images of others; exposure to harmful content such as harassment or depictions of violence or self-harm; and crowding out time spent on other activities that promote psychological wellbeing.

15. Fourth, SB 976 imposes limits on social media applications' use of two tools on children: a) push notifications; and b) use of information provided by the child user, or garnered from the device the child uses to access the site or application, to inform algorithms that choose which media to display to that child in their social media feed (hereafter I refer to these as "personalized feeds"). Research shows that push notifications can increase engagement with mobile applications generally, and that personalized feeds increase time spent on the application as compared to feeds that simply present posts in reverse chronological order. Therefore, limiting or restricting the application of these tools to children is an evidence-supported strategy for reducing the amount of time children spend on social media.

16. Therefore, it is my professional opinion that SB 976 could improve children's mental health in California by reducing the amount of time children spend on social media, particularly during school hours and sleep hours.

I. THE RELATIONSHIP BETWEEN SOCIAL MEDIA AND MENTAL HEALTH AMONG CHILDREN

A. Introduction

17. In 2019, my colleagues and I used a large, nationally representative, publicly available survey to study the relationship between the amount of time youth spend on social media and their subsequent mental health outcomes.[2] In this section I will describe the motivations for our research. I will discuss our study methods and conclusions. I will situate my own findings in the broader literature of observational studies – those that do not have a formal "experiment" – on the relationship between social media and mental health.

B. Motivation for Research

18. The primary motivation for our 2019 study was that social media use is ubiquitous among U.S. teens—a fact that remains true. For example, a 2023 nationally representative survey from Pew Research Center examined teens (age 13-17) use of five popular social media applications, YouTube, TikTok, Snapchat, Instagram, and Facebook. It found the proportion of teens who use these applications daily was 71%, 58%, 51%, 47%, and 19% respectively; and the proportion who use them "almost constantly" was 16%, 17%, 14%, 8%, and 3% respectively. The survey also assessed internet usage more broadly and found that 46% of teens say they are online "almost constantly." [3] This remarkable change in how U.S. youth spend their time from just a few decades ago, when social media did not exist, is an important area for scientific and social scientific research across a wide variety of domains.

19. My team's study was also motivated by past research showing a positive correlation between social media use and depressive symptoms during childhood and

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[2] Riehm KE, Feder KA, Tormohlen KN, Crum RM, Young AS, Green KM, et al. Associations Between Time Spent Using Social Media and Internalizing and Externalizing Problems Among US Youth. JAMA psychiatry. 2019;1–9.

[3] Anderson M, Faverio M, Gottfried J. Teens, Social Media and Technology 2023 [Internet]. Pew Research Center. 2023 [cited 2024 Nov 20]. Available from: https://www.pewresearch.org/internet/2023/12/11/teens-social-media-and-technology-2023/

adolescence,[4] and symptoms of antisocial personality disorder;[5] as well as other more broadly focused studies showing positive associations of youth screen time with symptoms of multiple emotional disorders,[6] and total media exposure in adolescents with depression in adulthood.[7] Finally, we were motivated by research showing population-wide increases in the prevalence of depressive symptoms,[8] and suicide attempts and deaths,[9, 10] among U.S. youth over the course of the 2010s, corresponding to the period when social media use increased in prevalence among U.S. youth.

C. Research Methods

20. Our study used data collected as part of the larger "Population Assessment of

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[4] McCrae N, Gettings S, Purssell E. Social Media and Depressive Symptoms in Childhood and Adolescence: A Systematic Review. Adolescent Res Rev. 2017 Dec 1;2(4):315–30.

[5] Galica VL, Vannucci A, Flannery KM, Ohannessian CM. Social Media Use and Conduct Problems in Emerging Adults. Cyberpsychology, Behavior, and Social Networking. 2017 Jul;20(7):448–52.

[6] Zink J, Belcher BR, Kechter A, Stone MD, Leventhal AM. Reciprocal associations between screen time and emotional disorder symptoms during adolescence. Preventive Medicine Reports. 2019 Mar 1;13:281–8.

[7] Primack BA, Swanier B, Georgiopoulos AM, Land SR, Fine MJ. Association Between Media Use in Adolescence and Depression in Young Adulthood: A Longitudinal Study. Archives of General Psychiatry. 2009 Feb 1;66(2):181–8.

[8] Mojtabai R, Olfson M, Han B. National Trends in the Prevalence and Treatment of Depression in Adolescents and Young Adults. Pediatrics. 2016 Dec 1;138(6):e20161878.

[9] Hedegaard H, Curtin SC, Warner M. Suicide Mortality in the United States, 1999–2017. NCHS Data Brief No. 330. Hyattsville, MD: National Center for Health Statistics; 2018.

[10] Burstein B, Agostino H, Greenfield B. Suicidal attempts and ideation among children and adolescents in US emergency departments, 2007-2015 [published online April 8, 2019]. JAMA Pediatr. doi:10.1001/jamapediatrics.2019.0464

Tobacco and Health" (PATH) study. The detailed methods of the PATH study are publicly available.[11] PATH was a large, nationally representative cohort study of U.S. youth and adults. A "cohort study" is a study where researchers follow up with the same participants repeatedly to see how those participants health status changes over time. The primary purpose of the PATH study was to study the prevalence and correlates of tobacco product use. Our study used publicly available, non-identifiable data collected from 6,595 youth aged 12-15 who completed the PATH study "Wave 1" interview between September 2013 and December 2014. Those participants were selected because they also participated in "Wave 2" interviews one year after enrollment (at which time they were age 13-16), and "Wave 3" interviews two years after enrollment (at which time they were age 14-17).

21. Our study outcome was participants' self-reported symptoms of mental and behavioral health problems at Wave 3. Specifically, the outcome was based on participants responses to a scale included in the PATH survey, the "Global Appraisal of Individual Needs – Short Screener" (GAIN-SS). GAIN-SS is short screening tool for identifying youth mental health and behavioral health problems that has been previously validated and is widely used in research.[12, 13]

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[11] Hyland A, Ambrose BK, Conway KP, Borek N, Lambert E, Carusi C, et al. Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. Tobacco control. 2017;26(4):371–8.

[12] Dennis ML, Chan YF, Funk RR. Development and Validation of the GAIN Short Screener (GSS) for Internalizing, Externalizing and Substance Use Disorders and Crime/Violence Problems Among Adolescents and Adults. The American Journal on Addictions. 2006;15(s1):s80–91.

[13] McDonell MG, Comtois KA, Voss WD, Morgan AH, Ries RK. Global Appraisal of Individual Needs Short Screener (GSS): Psychometric Properties and Performance as a Screening Measure in Adolescents. The American Journal of Drug and Alcohol Abuse. 2009 Jan 1;35(3):157–60.

22. We used data from two sub-scales within the GAIN-SS.

23. The first subscale assesses adolescent "internalizing problems," which are related to psychiatric disorders like depression or anxiety. Research shows internalizing problems in youth are predictive of negative mental health, social, and economic outcomes in adulthood.[14] The sub-scale specifically assesses four self-reported internalizing symptoms: "Feeling very trapped, lonely, sad, blue, depressed, or hopeless about the future;" "Sleep trouble, such as bad dreams, sleeping restlessly, or falling asleep during the day;" "Feeling very anxious, nervous, tense, scared, panicked, or like something bad was going to happen;" and "Becoming very distressed and upset when something reminded you of the past."

24. The second subscale assesses adolescent "externalizing problems," which are related to psychiatric disorders like Attention Deficit Hyperactivity Disorder (ADHD) and Conduct Disorder. Like internalizing problems, research shows externalizing problems in youth are predictive of negative mental health, social, and economic outcomes in adulthood.[15] The sub-scale specifically assesses seven self-reported externalizing symptoms: "Lied or conned to get things you wanted or to avoid having to do something;" "Had a hard time paying attention at school, work, or home;" "Had a hard time listening to instructions at school, work, or home;" "Were a bully or threatened other people;" "Started physical fights with other people;" "Felt restless or the need to run around or climb on things;" and "Gave answers before the other person finished asking the question."

25. Consistent with past research, we classified youth as having internalizing or externalizing problems if they endorsed four or more symptoms from each respective sub-scale,

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[14] Vergunst F, Commisso M, Geoffroy MC, Temcheff C, Poirier M, Park J, et al. Association of Childhood Externalizing, Internalizing, and Comorbid Symptoms With Long-term Economic and Social Outcomes. JAMA Network Open. 2023 Jan 9;6(1):e2249568.

[15] Vergunst F, Commisso M, Geoffroy MC, Temcheff C, Poirier M, Park J, et al. Association of Childhood Externalizing, Internalizing, and Comorbid Symptoms With Long-term Economic and Social Outcomes. JAMA Network Open. 2023 Jan 9;6(1):e2249568.

and as having both internalizing and externalizing problems if they endorsed four or more items on each scale.[16,17]

26. The primary exposure of interest in our study was the amount of time youth said they spent on social media "on a typical day." This exposure was measured at Wave 2. Responses were: "no time" (which included not using the internet or not having a social media account), "up to 30 minutes," "more than 30 minutes, up to 3 hours," "3 to 6 hours," and "more than 6 hours."

27. In addition, we included in our study a number of other factors measured at Wave 1 for "regression adjustment" (see description of statistical methods below). These included participant demographics (age, sex, race, and parent education level), self-reported body mass index, self-reported lifetime use of alcohol and cannabis, and self-reported mental health symptoms at Wave 1 (measured the same was as at Wave 3).

28. Our research question was whether youth who spent more time on social media at Wave 2 were more likely to experience internalizing problems, externalizing problems, or both at Wave 3. To answer this question, we fit a multinomial logistic regression model to predict which of the four mental health categories youth fell in at Wave 3 – no problems, internalizing problems, externalizing problems, or both types of problems – based on their self-reported volume of social media use at Wave 2, and adjusting for all the factors mentioned above as having been measured at wave 1. Roughly speaking, this "regression adjustment" means that youth with high levels of social media use were compared to youth with low levels of social media use but who were otherwise similar to them on all the other factors we adjusted for. We

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[16] Green VR, Conway KP, Silveira ML, Kasza KA, Cohn A, Cummings KM, et al. Mental Health Problems and Onset of Tobacco Use Among 12- to 24-Year-Olds in the PATH Study. Journal of the American Academy of Child & Adolescent Psychiatry. 2018 Dec 1;57(12):944-954.e4.

[17] Riehm KE, Young AS, Feder KA, Krawczyk N, Tormohlen KN, Pacek LR, et al. Mental Health Problems and Initiation of E-cigarette and Combustible Cigarette Use. Pediatrics. 2019 Jun 3;e20182935.

also conducted a test for linear trend between more social media use and higher odds of mental health problems. A significant linear trend is evidence of a "dose response;" in other words, each increase in time spent on social media is associated with concomitant further increase (or decrease) in the odds of later mental health problems.

D. Results

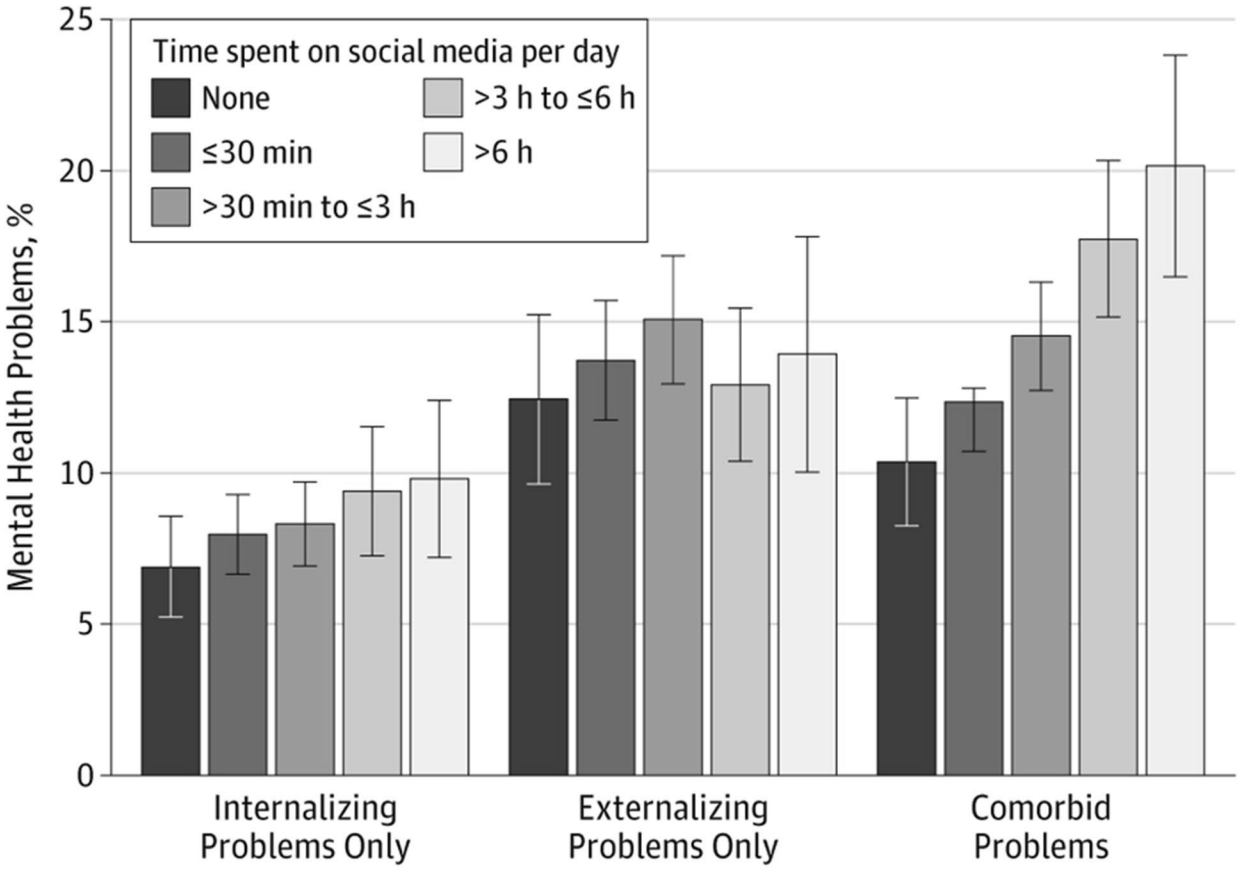
29. In our study sample, at Wave 2, 17% of youth did not use social media, 32% spent 30 minutes or less per day on social media, 31% used social media 30 minutes to 3 hours, 12% used social media 3 to 6 hours, and 8% used social media more than 6 hours. At Wave 3, 9% of participants met criteria for internalizing problems alone, 14% for externalizing problems alone, and 18% for both internalizing and externalizing problems.

30. We found that, as compared to youth who did not use social media, youth who used social media more than six hours per day at Wave 2 had 60% higher odds of experiencing internalizing problems at Wave 3 and 126% higher odds of experiencing both internalizing and externalizing problems at Wave 3. This was true even after adjusting for all the factors described above used in our regression adjustment. Figure 1 below shows the adjusted predicted probability of each mental health outcome at Wave 3 based participants' social media use at Wave 2, using our regression model. As can be seen, there is evidence for a so-called "dose response:" as time spent on social media at Wave 2 went up, so did the odds of internalizing problems and co-occurring internalizing and externalizing problems at Wave 3. This dose response relationship was confirmed by our test for trend. Roughly speaking, this is consistent with the hypothesis that "children who spend more time on social media experience progressively worse future mental health outcomes, even after accounting for children's past history of mental health problems."

31. Because the PATH sample was nationally representative, we were able to conduct an after-the-fact simulation to see, based on our model, what proportion of mental health problems at Wave 3 would have been prevented if all youth who used more than 30 minutes of social media per day instead used 30 minutes or less. The simulation combines two pieces of information: 1) the association between social media use and mental health outcomes observed in our statistical model; and 2) the distribution of the self-reported amount of time adolescents spent

on social media (e.g., 8% > 6 hours, 12% 3 to 6 hours, etc., see above) in the nationally representative survey dataset we used for our study. This is called a "population attributable fraction" estimate. The simulation predicted that 9% of all internalizing problems and about 7% of all externalizing problems at Wave 3 could have been prevented by reducing social media use to 30 minutes or less per day.

Figure 1. Adjusted Proportion of Internalizing Problems, Externalizing Problems, and Comorbid Internalizing and Externalizing Problems Stratified by Category of Time Spent on Social Media per Day Among US Adolescents in the Population Assessment of Tobacco and Health Study, 2013-2016



Error bars indicate 95% confidence intervals.

Adapted from Riehm KE, Feder KA, Tormohlen KN, Crum RM, Young AS, Green KM, et al. Associations Between Time Spent Using Social Media and Internalizing and Externalizing Problems Among US Youth. JAMA psychiatry. 2019;1–9.

E. Additional Research on Social Media and Mental Health

32. The preceding sections focused on my own research. Our study has a number of strengths: we used a large, nationally representative sample of adolescents; the survey we drew on asked about adolescent social media use using a realistic question that allowed us to measure the very large amount of time some adolescents spend on social media (as opposed to questions like "Do you use social media, yes or no?"); the survey measurement of social media use preceded the measurement of mental health outcomes by a year; and we were able to adjust for children's pre-existing mental health problems. However, even with these strengths, our findings should be considered in the context of a growing body of literature on the relationship between children's mental and behavioral health and their use of social media. A thorough and rigorous review of this literature exceeds what is possible in this report, but I highlight here three additional reviews that I think provide useful context to this discussion, and summarize some of the key conclusions of those reviews.

33. First, there is a Surgeon General's advisory on social media and youth mental health.[18] The report reviews the existing literature on social media and children's health and wellbeing across a variety of domains. It concludes that social media has both positive and negative impacts on children and adolescents, and that these impacts vary based on individual differences between children and based on context. It highlights several areas of particular concern, including potential exposure to harmful or inappropriate content such as hateful speech or suicide, harassment, fostering of negative self-image and body image, sleep problems, depression, and ADHD. The report reiterates the evidence that many children use social media for large portions of the day, with a sizable fraction saying they use it "almost constantly." It also highlights multiple research studies showing that a majority of children say they would have trouble stopping use if they wanted to, and a third of girls describe their use of social media as an "addiction." It also points to research showing that social media use is associated with triggering

[18] Murthy V. Social Media and Youth Mental Health: The US Surgeon General's Advisory; 2023.

of brain pathways similar to those implicated in addiction. Weighing the evidence, the report concludes "Nearly every teenager in America uses social media, and yet we do not have enough evidence to conclude that it is sufficiently safe for them."[19] On the basis of this research, the report recommends that policymakers "strengthen protections to ensure greater safety for children interacting with all social media platforms," including by "limiting the use of features that attempt to maximize time, attention, and engagement; [and] developing tools that protect activities that are essential for healthy development like sleep."[20]

34. Second is a meta-analysis by Ivie and colleagues of 12 different research studies examining the relationship between time spent on social media and depression symptoms.[21] A meta-analysis is a research study that statistically combines the quantitative findings of multiple other studies to try to try to pool the evidence generated by those studies to draw the most rigorous possible conclusions. This is useful because study findings on social media use are not consistent, and some find no association between social media use and mental health problems.[22] However, after pooling information across all 12 studies, this meta-analysis found a small but statistically significant correlation between time spent on social media and depression symptoms. Note that my study was not included as part of this meta-analysis, so this is independent evidence from 12 other studies that is, on average, consistent with the findings of my own research

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[19] Murthy V. Social Media and Youth Mental Health: The US Surgeon General's Advisory; 2023.

[20] Murthy V. Social Media and Youth Mental Health: The US Surgeon General's Advisory; 2023.

[21] Ivie EJ, Pettitt A, Moses LJ, Allen NB. A meta-analysis of the association between adolescent social media use and depressive symptoms. Journal of Affective Disorders. 2020 Oct 1;275:165–74.

[22] For example, see Jelenchick LA, Eickhoff JC, Moreno MA. "Facebook Depression?" Social Networking Site Use and Depression in Older Adolescents. Journal of Adolescent Health. 2013 Jan 1;52(1):128–30.

described above.

35. Third is a systematic review and meta-analysis by Sohn and colleagues that examined the relationship between "problematic smartphone usage" and mental health outcomes among children and youth.[23] The authors define "problematic smartphone usage" as "smart phone use associated with at least some element of dysfunctional use, such as anxiety when the phone was not available, or neglect of other activities."[24] Combining the results of 41 different independent scientific studies on this topic, the authors find that problematic smartphone use is associated with more than three times the odds of depression and anxiety, nearly two times the odds of perceived stress, and more than double the odds of poor sleep quality. Problematic smartphone use and social media use are not strictly the same thing. However, since research from a sample of U.S. teens suggests that 42% of time spent using smartphones is spent on social media apps other than YouTube, and another 19% is spent on YouTube, these topics are closely related.[25]

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[23] Sohn SY, Rees P, Wildridge B, Kalk NJ, Carter B. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: a systematic review, meta-analysis and GRADE of the evidence. BMC Psychiatry. 2019 Nov 29;19(1):356.

[24] Sohn SY, Rees P, Wildridge B, Kalk NJ, Carter B. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: a systematic review, meta-analysis and GRADE of the evidence. BMC Psychiatry. 2019 Nov 29;19(1):356.

[25] Radesky JS, Weeks HM, Schaller A, Robb MB, Mann S, Lenhart A. Constant Companion: A week in the life of a young person's smartphone use [Internet]. Common Sense Media; 2023. Available from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.commonsensemedia.org/sites/default/files/research/report/2023-cs-smartphone-research-report_final-for-web.pdf

F. Summary

36. To summarize, my own research, along with the other studies described above, are consistent with the following claims. First, frequent social media use is associated with several different adverse mental health outcomes. Second, there is evidence for a "dose response" relationship whereby the more time one spends on social media, the greater the likelihood of adverse mental health outcomes on average. Third, this finding is "prospective," in the sense that this finding persists in studies where the measurement of social media use precedes the measurement of mental health outcomes by a year. Fourth, this finding persists even after adjusting for potential common causes of social media use and mental health problems, like pre-existing mental health problems. Fifth, while not all studies produce consistent findings, the collection of existing evidence across multiple population studies suggests that the average association of more frequent social media use with children's mental health is negative.

II. Experimental Studies on the Effects of Limiting Social Media Use

37. In the first section of my declaration, I focused on observational studies examining the association of social media use with various adverse mental health outcomes. Observational studies are a critical component of epidemiology research, particularly in settings where experiments are challenging to conduct in an ethical way or in a large or representative population. However, the fact that more frequent social media use is associated with adverse mental health outcomes in observational studies does not necessarily mean that more social media use causes adverse mental health outcomes. While the results of the observational studies described above are consistent with the hypothesis that frequent social media use causes adverse mental health outcomes, their results are also consistent with other plausible alternative hypotheses: for example, is also possible that people with worse mental health use more social media, or that social media and mental health problem share a common cause. A key remaining question is the effect of interventions that actually change the amount of time children (or adults) spend on social media. Specifically, if children reduce their social media use, does this cause their mental health to improve on average?

38. To address this question, I review seven experimental studies in which participants were randomly assigned to interventions that, in one way or another, resulted in them reducing their social media use. I chose these studies because they comprise the set of published studies I was able to find that were conducted as a randomized experiment where participants were randomly assigned to either a "treatment" group, where they were incentivized or required to reduce their social media or screen media use, or to a "control" group, where they continued to use social or screen media as usual. Randomized experiments are a foundational approach in medical and scientific research, because they allow researchers to estimate the causal effect of a treatment or exposure on a health outcome of interest without concern that any observed association between the exposure and outcome resulted from some common cause of the two. In other words, unlike in observational studies, in a randomized trial, correlation *does* necessarily imply causation, whereas in in observational studies alternative explanations for correlation are possible. In addition, I only included studies where one of the measured outcomes in the experiment was a psychosocial or behavioral outcome such as depression symptoms, sleep problems, self-reported well-being, or time spent on social media post-intervention.

39. Before beginning my review, I note that my review does not meet the standards of a "systematic review." There are other experimental studies on social media and youth mental health that I was not able to review in the limited time permitted to prepare this declaration in response to Plaintiffs' motion for preliminary injunction. I want to be clear that I did not select the studies I was able to review individually because of their findings, and have noted null or contradictory findings pertaining to health when they are present within those studies. Further, in addition to my review of these individual studies, I also conclude this section with a discussion of a systematic review conducted by Plackett and colleagues (2023) that examined 23 published studies on behavioral interventions targeting social media use.[26]

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[26] Plackett R, Blyth A, Schartau P. The Impact of Social Media Use Interventions on Mental Well-Being: Systematic Review. Journal of Medical Internet Research. 2023 Aug 11;25(1):e44922.

40. Hunt and colleagues (2018) recruited 143 undergraduate students to an experimental study on social media use and well-being.[27] Participants were randomly assigned to two conditions. In the treatment condition, participants were asked to limit their use of three social media applications – Facebook, Instagram, and Snapchat – to 10 minutes per day per platform, over a period of 3 weeks. In the control condition, participants were not asked to limit their social media use. Both groups were asked to send screenshots documenting their time spent on social media. At the time of enrollment in the study, and again three weeks later at the study's conclusion, participants completed commonly used and well-validated psychometric assessments of: social support, "fear of missing out" (FoMO), loneliness, anxiety, depression, self-esteem, and autonomy and self-acceptance. At the end of the study, the treatment condition experienced significant reductions in loneliness and depression as compared to the control group; there were no differences between the groups on other outcomes.

41. Davis and Goldfield (2024) recruited a group of 220 Canadian undergraduate students who self-reported recent "emotional distress" into an experimental study on the mental health effects of social media.[28] Participants were randomly assigned to two conditions. In the treatment condition, participants were asked to limit their social media use to one hour per day over a period of three weeks, and to send daily screenshots documenting the amount of time spent on social media the previous day. In the control condition, participants were not asked to limit their social media use, but were similarly asked to send screenshots documenting their time spent on social media. At the time of enrollment in the study, and again three weeks later at the study's conclusion, participants completed assessments of depression symptoms, anxiety symptoms, "fear

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[27] Hunt MG, Marx R, Lipson C, Young J. No More FOMO: Limiting Social Media Decreases Loneliness and Depression. Journal of Social and Clinical Psychology. 2018;37(10):751–68.

[28] Davis CG, Goldfield GS. Limiting social media use decreases depression, anxiety, and fear of missing out in youth with emotional distress: A randomized controlled trial. Psychology of Popular Media. 2024.

of missing out" (FoMO), and sleep time. At the end of the study, participants in the treatment condition experienced significantly greater reductions in depression, anxiety, and fear of missing, and significantly greater increases in sleep time, than participants in the control condition.

42. Thai and colleagues (2024) followed the same protocol as Davis and Goldfield to study the effects of social media use on appearance esteem and weight esteem.[29] Both outcomes were assessed using the Body Esteem Scale for Adults and Adolescents. Appearance esteem questions were questions like "I'm pretty happy about the way I look." Weight esteem questions were questions like "I am satisfied with my weight." After three weeks, participants asked to reduce their social media to 1 hour per week experienced statistically significant improvements in both measures of self-image. Participants in the control condition experienced no improvement.

43. Smith and colleagues (2024) conducted a small randomized trial of 66 female undergraduates who were randomly assigned to either take a one-week complete break from social media or continue use as usual.[30] Similar to Thai and colleagues, they found that, after one week, participants assigned to take a break from social media had higher body satisfaction and higher state self-esteem than participants in the control condition.

44. Alcott and colleagues (2020) used Facebook advertising to recruit 2,897 adults who use Facebook for an experimental study on the welfare effects of social media.[31] Participants randomized to the experimental condition de-activated their Facebook profiles for the four weeks preceding the U.S. 2018 mid-term election. Participants in the control condition were not asked to

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[29] Thai H, Davis CG, Mahboob W, Perry S, Adams A, Goldfield GS. Reducing social media use improves appearance and weight esteem in youth with emotional distress. Psychology of Popular Media. 2024;13(1):162–9.

[30] Smith OE, Mills JS, Samson L. Out of the loop: Taking a one-week break from social media leads to better self-esteem and body image among young women. Body Image. 2024 Jun 1;49:101715.

[31] Allcott H, Braghieri L, Eichmeyer S, Gentzkow M. The Welfare Effects of Social Media. American Economic Review. 2020 Mar;110(3):629–76.

change their social media use. After four weeks, participants randomized to deactivate Facebook experienced small but statistically significant improvements in multiple measures of well-being: happiness, life-satisfaction, depression, and anxiety as compared to the control condition. Participants in the Facebook deactivation condition also spent an average of 60 minutes per day less online, and reduced their use of other social media apps such as Twitter in addition to Facebook. This time was instead spent on activities like watching TV alone and socializing with family and friends. After the experiment ended, the treatment group's self-reported time spent on Facebook remained 22% lower than the control group.

45. Allcott and colleagues (2022) also conducted a second experiment to examine specifically whether social media applications, along with phone-based web browsers, are habit-forming, in the sense that people use social media more than they want to out of habit, and struggle to stop using social media.[32] 2,000 participants were provided a customized app that assisted them with tracking and setting limits on their screen time. Participants were then randomly assigned to one of three experimental conditions: a) they were offered additional financial incentives to limit social media and browser use; b) they were offered no financial incentive, but were provided additional functionality that made it easier for them to limit their social media and browser use by allowing them to block applications in a way that could not be reversed; or c) neither, the control group. Among those paid a bonus to reduce social media and browser use, screen time use fell as compared to the control group, and remained 19 minutes per day less than the control group even after incentive payments ended. This suggests that using incentives helped participants reduce an unwanted habit of using social media. Among participants who were provided functionality that made it easier to limit social media use, 78% used that functionality even though they were provided no incentive to do so. The result was a 22-minute-per-day reduction in social media use as compared to the control group. In addition, both experimental conditions resulted in improvements in measures of phone addiction and Facebook

[32] Allcott H, Gentzkow M, Song L. Digital Addiction. American Economic Review. 2022 Jul;112(7):2424–63.

addiction (measured using previously validated scales). The authors use mathematical models based on their experimental results to estimate that close to one-third of all time spent on social media is attributable to self-control problems.

46. Finally, Schmidt-Persson and colleagues (2024) describe the results of a randomized trial 89 Danish households with a total of 181 child participants.[33] That study examined a multi-part intervention designed to reduce screen media use generally. All families were, based on a prior survey, among the to 40% of Danish households in terms of screen leisure time. Forty-five families with 86 children received the two-week intervention. Those who received the intervention were required to hand over all smart phones used by children, as well as at least one smart phone used by an adult; all participants who handed over their phones received simple replacement phones capable of calling and texting for the duration of the study. Participants were further asked to limit their non-phone screen leisure time, including computer and television, to 3 hours per week or less. An additional 30 minutes were permitted for "essential" screen activities such as schoolwork or scheduling activities. Signs were posted around the house reminding residents about screen time limits. The remaining 44 families with 85 children assigned to the control condition did not receive any components of this intervention. Children and adolescents who participated in the study completed the "Strengths and Difficulties Questionnaire:" a widely used instrument that measures internalizing, externalizing, conduct, hyperactivity, emotional, and peer relationship problems, as well as pro-social behavior, and also provides a combined "difficulties score" that combines all these measures. (See section I-C for an explanation of "internalizing" and "externalizing" problems.) After two weeks, as compared to the control group, children who received the intervention experienced statistically significant improvements in self-reported symptoms of both a) internalizing problems and b) peer relationship problems, and an overall improvement in their difficulties score, as well as

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[33] Schmidt-Persson J, Rasmussen MGB, Sørensen SO, Mortensen SR, Olesen LG, Brage S, et al. Screen Media Use and Mental Health of Children and Adolescents: A Secondary Analysis of a Randomized Clinical Trial. JAMA Network Open. 2024 Jul 12;7(7):e2419881.

corresponding increases in their prosocial behavior. There were no statistically significant differences in other outcomes. Finally, in a separate published analysis of the same randomized trials, the authors found that the same screen time intervention above increased children's non-sedentary leisure activities by an average of 46 minutes per day, but found no significant effect on sleep quality.[34]

47. In addition to the individual studies described above, I also want to highlight a 2023 "systematic review," conducted by Plackett and colleagues, of published studies evaluating interventions that seek to help participants improve their mental health by reducing, eliminating, or better managing social media use.[35] Unlike my review above, Plackett's review is "systematic" in that it used a pre-specified search strategy intended to capture all studies related to social media interventions, reviewed multiple large databases of scientific studies, and includes all relevant studies found in those databases between 2004 and 2022. They identified 23 qualifying studies. (One of the studies in Plackett's review was Hunt and colleagues' 2018 study noted above in my testimony. None of the other studies I have described in my testimony were included in Plackett's review, mostly because they were published after 2022.) Plackett and colleagues found "some evidence" that social media interventions are effective in improving mental well-being, with the strongest evidence for improvements in depression. Plackett and colleagues also found results of interventions on other mental health outcomes were mixed across studies. Finally, they found that the quality of the studies they reviewed was mostly "poor," with the primary reason for poor quality being that most studies were conducted on convenience samples of college students.

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[34] Pedersen J, Rasmussen MGB, Sørensen SO, Mortensen SR, Olesen LG, Brønd JC, et al. Effects of Limiting Recreational Screen Media Use on Physical Activity and Sleep in Families With Children: A Cluster Randomized Clinical Trial. JAMA Pediatrics. 2022 Aug 1;176(8):741–9.

[35] Plackett R, Blyth A, Schartau P. The Impact of Social Media Use Interventions on Mental Well-Being: Systematic Review. Journal of Medical Internet Research. 2023 Aug 11;25(1):e44922.

48. In summary, these experimental studies show, across a range of populations, that interventions to reduce time spent on social media (or, in one case, screen leisure time generally) result in improved mental health, in some cases self-image, and in some cases sleep. Further, these experiments show that people who receive interventions to reduce their social media use continue to do so even after interventions have ended, and that people empowered to set limits on their social media use mostly do choose to set such limits, even when they are provided no incentive to do so. These results corroborate and strengthen the implications of the population health research described above. These implications are: first, a substantial fraction of social media use is unwanted use due to habit formation; second, spending less time using social media improves mental health and wellbeing outcomes like depression, anxiety, self-image, and sleep duration.

49. It is important to acknowledge some of the limitations of the research I reviewed above. First, none of the studies above is a perfect analog for the Act under consideration. The first four included undergraduate students as research participants. The second two were conducted in the general population of adults with a Facebook profile. This limits the generalizability of these studies: the effects of limiting social media use among children and adolescents may be different than the effects of limiting social media use among young adult college students or adults who use Facebook. The final study did focus on children, but that study was conducted outside the United States and analyzed limits on all screen leisure time, not solely social media use. However, while the effects of limiting solely social media use may be somewhat different than the effects of limiting screen leisure time, as noted above, youth social media use and youth screen leisure time are largely overlapping categories since research suggests the majority of all time youth spend on their smartphones is spent on social media.[36]

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[36] Radesky JS, Weeks HM, Schaller A, Robb MB, Mann S, Lenhart A. Constant Companion: A week in the life of a young person's smartphone use [Internet]. Common Sense Media; 2023. Available from: chrome-

(continued…)

50. The key point is that the experimental findings above corroborate the results of the observational research that I have already described in the first section of this declaration, which was conducted in large, U.S.-based samples of children. Therefore, because it is true that 1) more social media use is associated with worse mental health outcomes in large representative studies; and because it is true that 2) reducing social media use causes mental health improvements in controlled experiments; and because it is true that 3) very high levels of social media use are common among U.S. children, it is reasonable to conclude that policies that effectively reduce time spent on social media by U.S. children should, all other things being equal, result in overall improvements in the mental health of those children.

51. An additional important addendum to this summary is worth noting: While the experimental studies I reviewed are consistent in their conclusion that reducing time spent on social media improves mental health, they are also reasonably consistent in concluding that the size of these benefits is generally moderate, with somewhat larger benefits for youth who are already experiencing some form of emotional distress. (Which makes sense – your mental health cannot improve much if you are already doing well.) For example, Allcott and colleagues point out the effects they observe tend to be smaller than the effects of evidence-based psychotherapy (although a longer intervention might have more substantial effects).[37] However, because a) very high levels of social media use are so ubiquitous among youth, b) experiments show that this behavior appears to be unwanted, and c) this behavior can be changed (at least in the short term) through relatively straightforward technological and behavioral interventions, it is plausible that interventions targeting social media use hold promise to achieve these mental health benefits for many young people.

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extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.commonsensemedia.org/sites/default/files/research/report/2023-cs-smartphone-research-report_final-for-web.pdf

[37] Allcott H, Braghieri L, Eichmeyer S, Gentzkow M. The Welfare Effects of Social Media. American Economic Review. 2020 Mar;110(3):629–76.

III. REASONS WHY SOCIAL MEDIA USE MAY BE LINKED TO CHILDREN'S MENTAL HEALTH

52. I now consider why and how reducing time spent on social media may improve mental health of children (and, for that matter, adults). It is important to note that this is an active area of research. Thus, while I will offer four hypotheses and present evidence supporting them, none of these explanations is conclusive. These hypotheses are based on my review of relevant studies and research, cited below.

53. The first and most straightforward explanation offered by researchers who have examined the relationship between social media and mental health is the effect of social media use on sleep. Adequate sleep duration and quality plays a critical role in health brain development, and sleep disturbances are associated with "nearly all psychiatric and developmental disorders" in adolescents.[38] Research shows that child and adolescent "screen time" can come at the expense of sleep.[39] This is why organizations like the American Sleep Foundation and Mayo Clinic recommend keeping devices with screens out of children's bedrooms during sleep time entirely.[40, 41] As described above, more frequent adolescent social media use is consistently associated with less sleep,[42] particularly when social media use involves

[38] Tarokh L, Saletin JM, Carskadon MA. Sleep in adolescence: Physiology, cognition and mental health. Neuroscience & Biobehavioral Reviews. 2016 Nov 1;70:182–8.

[39] Hale L, Guan S. Screen Time and Sleep among School-Aged Children and Adolescents: A Systematic Literature Review. Sleep Med Rev. 2015 Jun;21:50–8.

[40] Suni E, Singh A. Sleep Foundation. 2020 [cited 2024 Nov 23]. Technology in the Bedroom. Available from: https://www.sleepfoundation.org/bedroom-environment/technology-in-the-bedroom

[41] Mayo Clinic Health System [Internet]. [cited 2024 Nov 23]. Children and too much screen time. Available from: https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/children-and-screen-time

[42] Alonzo R, Hussain J, Stranges S, Anderson KK. Interplay between social media use, (continued…)

screen time in the evening and at bedtime,[43, 44] and experimental research showed limiting social media use caused increased sleep time among youth with emotional distress.[45]

54. A second important explanation offered by researchers is that constant comparison with idealized images of others could result in worse body image and self-esteem, particularly for adolescent girls. As described in the Surgeon General's Advisory: "A synthesis of 20 studies demonstrated a significant relationship between social media use and body image concerns and eating disorders, with social comparison as a potential contributing factor…."[46] When asked about the impact of social media on their body image, nearly half (46%) of adolescents aged 13–17 said social media makes them feel worse, 40% said it makes them feel neither better nor worse, and only 14% said it makes them feel better."[47]

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sleep quality, and mental health in youth: A systematic review. Sleep Medicine Reviews. 2021 Apr 1;56:101414.

[43] Hysing M, Pallesen S, Stormark KM, Jakobsen R, Lundervold AJ, Sivertsen B. Sleep and use of electronic devices in adolescence: results from a large population-based study. BMJ Open. 2015 Jan 1;5(1):e006748. 1.

[44] van den Eijnden RJJM, Geurts SM, ter Bogt TFM, van der Rijst VG, Koning IM. Social Media Use and Adolescents' Sleep: A Longitudinal Study on the Protective Role of Parental Rules Regarding Internet Use before Sleep. Int J Environ Res Public Health. 2021 Feb;18(3):1346.

[45] Davis CG, Goldfield GS. Limiting social media use decreases depression, anxiety, and fear of missing out in youth with emotional distress: A randomized controlled trial. Psychology of Popular Media. 2024.

[46] Holland G, Tiggemann M. A systematic review of the impact of the use of social networking sites on body image and disordered eating outcomes. Body Image. 2016 Jun 1;17:100–10.

[47] Bickham DS, Hunt E, Bediou B, Rich M. Adolescent media use: Attitudes, effects, and

(continued…)

55. A third explanation offered by researchers is that exposure to harmful content or activity such as harassment, violent images, glorification of self-harm or suicide, or predatory behavior. Of course, social media can also be an important source of information for beneficial content, such as education, entertainment, or socializing. This is a vast area of research that is outside my area of expertise, but it is addressed in the Surgeon General's Advisory.[48] Since SB 976 does not prohibit specific content or topics, and instead regulates the use of algorithms that select which media to display, I will make only two brief points. First, there is clear agreement among experts in youth media consumption and health that the content youth consume can vary enormously from person to person, and the choice of content matters. This is why AAP offers guidelines on "Healthy Media Use Habits"[49] and encourages the use of individualized family media plans that consider time spent, settings for use, and content choices. [50] Second, as recently as 2022, nearly half of all U.S. teens reported having experienced cyberbullying.[51] A 2015 review

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online experiences. Boston, MA: Boston Children's Hospital Digital Wellness Lab. 2022. Retrieved from https://digitalwellnesslab.org/wpcontent/uploads/Pulse-Survey_Adolescent-Attitudes-Effectsand-Experiences.pdf.

[48] Murthy V. Social Media and Youth Mental Health: The US Surgeon General's Advisory; 2023.

[49] HealthyChildren.org [Internet]. 2019 [cited 2024 Nov 23]. Beyond Screen Time: Help Your Kids Build Healthy Media Use Habits. Available from: https://www.healthychildren.org/English/family-life/Media/Pages/healthy-digital-media-use-habits-for-babies-toddlers-preschoolers.aspx.

[50] COUNCIL ON COMMUNICATIONS AND MEDIA. Media Use in School-Aged Children and Adolescents. Pediatrics. 2016 Nov 1;138(5):e20162592.

[51] Vogels EA. Teens and Cyberbullying 2022 [Internet]. Pew Research Center. 2022 [cited 2024 Nov 23]. Available from: https://www.pewresearch.org/internet/2022/12/15/teens-and-cyberbullying-2022/.

article found a consistent relationship between cyberbullying and depression among children.[52] That 2015 review estimated fewer than a quarter of youth have experienced cyberbullying, suggesting that the problem of harassment online in particular may have become more severe in recent years.[53]

56. Finally, it may be that when youth reduce their social media use, their mental health improves because social media use was "crowding out" other activities that promote psychological wellbeing. As noted above, Allcott and colleagues estimated that close to a third of all time that adults spent on social media was attributable to self-control problems,[54] and found that deactivating social media led to more time spent on other activities such as socializing with friends and family.[55] Pedersen and colleagues found that restricting children's access to screen leisure time resulted in an additional 45 minutes per day on average spent on non-sedentary leisure activities.[56] Increased physical activity is associated with better mental health outcomes

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[52] Hamm MP, Newton AS, Chisholm A, Shulhan J, Milne A, Sundar P, et al. Prevalence and Effect of Cyberbullying on Children and Young People: A Scoping Review of Social Media Studies. JAMA Pediatrics. 2015 Aug 1;169(8):770–7.

[53] Hamm MP, Newton AS, Chisholm A, Shulhan J, Milne A, Sundar P, et al. Prevalence and Effect of Cyberbullying on Children and Young People: A Scoping Review of Social Media Studies. JAMA Pediatrics. 2015 Aug 1;169(8):770–7.

[54] Allcott H, Gentzkow M, Song L. Digital Addiction. American Economic Review. 2022 Jul;112(7):2424–63.

[55] Allcott H, Braghieri L, Eichmeyer S, Gentzkow M. The Welfare Effects of Social Media. American Economic Review. 2020 Mar;110(3):629–76.

[56] Pedersen J, Rasmussen MGB, Sørensen SO, Mortensen SR, Olesen LG, Brønd JC, et al. Effects of Limiting Recreational Screen Media Use on Physical Activity and Sleep in Families With Children: A Cluster Randomized Clinical Trial. JAMA Pediatrics. 2022 Aug 1;176(8):741–9.

among children.[57] Finally, a key activity for children is spending time in school and academic engagement more generally. In a recent nationally representative survey, 7 in 10 high school teachers said that students being distracted by their cellphones is a major problem in their classroom; this was the most frequently endorsed problem by teachers, exceeding even the proportion concerned about students "showing little to no interest in learning."[58] More frequent smartphone use is negatively correlated with academic achievement.[59] In summary, if children's social media use is attributable to unwanted habits or self-control problems, then social media use could interfere with other activities that foster positive mental health and healthy development such socializing, physical activity, academic engagement, and (as noted above) sleep.

IV. PUSH NOTIFICATIONS AND PERSONALIZED FEEDS

57. I am aware that SB 976 prohibits social media applications from sending push notifications to children during sleep or school hours. It also prohibits, absent verifiable parental consent, the use of "personalized" social media feeds when choosing which content to display to children (see "Opinions" above for definition of "personalized feeds"). While my own research does not examine these specific tools, for reasons described below, my understanding from published research is that it is plausible these requirements will result in improvements in children's mental health in California by reducing the amount of time children spend on social media.

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[57] Biddle SJH, Ciaccioni S, Thomas G, Vergeer I. Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. Psychology of Sport and Exercise. 2019 May 1;42:146–55.

[58] Horowitz LL Kim Parker and Juliana Menasce. What's It Like To Be a Teacher in America Today? [Internet]. Pew Research Center. 2024 [cited 2024 Nov 23]. Available from: https://www.pewresearch.org/social-trends/2024/04/04/whats-it-like-to-be-a-teacher-in-america-today/.

[59] Amez S, Baert S. Smartphone use and academic performance: A literature review. International Journal of Educational Research. 2020 Jan 1;103:101618.

58. First, as noted, a substantial proportion of time spent on social media appears to be attributable to habit formation, not optimal or intentional allocation of time.[60] It is therefore generally plausible that changes to features that increase user engagement and shape user behavior could have substantial effects on the total time a minor spends on social media sites or applications.

59. In the case of personalized feeds, randomized experiments by a team of researchers conducted in partnership with Meta showed that when personalized Facebook and Instagram feeds were replaced with reverse-chronological feeds (where content is simply displayed with most recent posts at the top of the feed), time spent on the application declines dramatically.[61]

60. In the case of push notifications, while I could not find any published studies on push notifications sent by social media platforms specifically, published studies of mobile phone applications developed by researchers in order to promote healthy behavior in adults showed that push notifications increased engagement with and time spent on those applications.[62, 63] A small randomized trial of adults found that turning off push notifications across all applications during

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[60] Allcott H, Gentzkow M, Song L. Digital Addiction. American Economic Review. 2022 Jul;112(7):2424–63.

[61] Guess AM, Malhotra N, Pan J, Barberá P, Allcott H, Brown T, et al. How do social media feed algorithms affect attitudes and behavior in an election campaign? Science. 2023 Jul 28;381(6656):398–404.

[62] Bidargaddi N, Almirall D, Murphy S, Nahum-Shani I, Kovalcik M, Pituch T, et al. To Prompt or Not to Prompt? A Microrandomized Trial of Time-Varying Push Notifications to Increase Proximal Engagement With a Mobile Health App. JMIR mHealth and uHealth. 2018 Nov 29;6(11):e10123.

[63] Bell L, Garnett C, Bao Y, Cheng Z, Qian T, Perski O, et al. How Notifications Affect Engagement With a Behavior Change App: Results From a Micro-Randomized Trial. JMIR mHealth and uHealth. 2023 Jun 9;11(1):e38342.

work hours reduced work interruptions and increased self-reported perceived productivity, consistent with past research on distractions.[64] Small randomized trials suggest that "batching" notifications – when notifications are sent in batches at regularly scheduled intervals instead of immediately throughout the day – generally improves self-reported attentiveness, productivity, mood, and sense of control over one's phone,[65] but that eliminating notifications entirely does not have these same benefits and may result in increased anxiety and fear of missing out. [66, 67]

61. A limitation of the research described above on personalized feeds and push notifications is that those studies were conducted on adults. However, there is no reason to think the ability of these tools to increase time spent on social media would be substantially different in children, particularly since frontal brain regions that play a key role in planned decision making and self-control typically develop fully only after adolescence.[68] In short, the collection of findings above are consistent with the hypothesis that limiting the use of personalized feeds and push notifications on children could reduce the amount of time children spend on social media. And the research described in sections I-III of this declaration suggests that, if children reduce the

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[64] Ohly S, Bastin L. Effects of task interruptions caused by notifications from communication applications on strain and performance. J Occup Health. 2023 Jun 6;65(1):e12408.

[65] Fitz N, Kushlev K, Jagannathan R, Lewis T, Paliwal D, Ariely D. Batching smartphone notifications can improve well-being. Computers in Human Behavior. 2019 Dec 1;101:84–94.

[66] Fitz N, Kushlev K, Jagannathan R, Lewis T, Paliwal D, Ariely D. Batching smartphone notifications can improve well-being. Computers in Human Behavior. 2019 Dec 1;101:84–94.

[67] Dekker CA, Baumgartner SE, Sumter SR, Ohme J. Beyond the Buzz: Investigating the Effects of a Notification-Disabling Intervention on Smartphone Behavior and Digital Well-Being. Media Psychology. 0(0):1–27.

[68] Johnson SB, Blum RW, Giedd JN. Adolescent Maturity and the Brain: The Promise and Pitfalls of Neuroscience Research in Adolescent Health Policy. J Adolesc. Health. 2009 Sep;45(3):216–21.

amount of time they spend on social media, their mental health will improve.

CONCLUSIONS

62. My own research, as well as the review of published research by others presented above, supports the hypothesis that a law limiting minors' engagement with social media is a public health intervention that could result in improvements in the mental health of children in California. I reach this conclusion for the following reasons.

63. First, children and youth who spend more time on social media experience worse mental health outcomes across multiple domains of mental health. In particular, frequent social media use is associated with negative sleep, depression, anxiety, and self-image and body self-esteem outcomes. Further, very high levels of social media use are common among U.S. youth. This suggests that interventions that reduce the amount of time children spend on social media use could have benefits for many children.

64. Second, multiple randomized trials—conducted with different age groups and across different settings, and published in peer reviewed scientific journals—found that temporarily limiting or restricting access to social media improved participants' subjective wellbeing, self-image and body image, depression and anxiety symptoms, and sleep quality, although precise findings vary from study to study. Randomized trials also show that, when participants received interventions to help them reduce their social media use, those who were the subjected to the interventions kept reducing their social media use even after interventions ended. Thus, the existing experimental evidence corroborates the notion that a substantial portion of time spent on social media is due to habit formation, not goal-directed or utility-maximizing behavior, and that reducing time spent on social media improves mental health.

65. Third, research suggests a number of plausible explanations for why using more social media could lead to worse mental health among children. First, frequent social media use is associated with reduced sleep time and worse sleep quality. Sleep duration and quality are both essential to adolescent psychological well-being and brain development. Second, use of social media may create a forum where youth constantly compare themselves to idealized images of others. This may foster low self-esteem and negative self-image, particularly in adolescent girls.

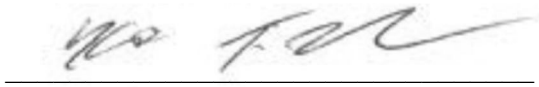
Third, children may be exposed to harassment or harmful content on social media, and survey studies suggest that cyberbullying is a common experience among youth today (although that bullying may or may not take place on social media). Fourth, because research shows that a substantial proportion of time spent on social media appears to be due to habit formation and self-control problems, time spent on social media use may crowd out time that would otherwise be spent on activities that promote positive mental health such as socializing, physical activity, or academic engagement.

66. Fourth, there is evidence that push notifications and personalized social media feeds are tools that can increase user engagement with social media applications. By limiting the use of push notifications during sleep hours and school hours, SB 976 has not only adopted a strategy that seems likely to reduce overall time spent on social media, but it has also adopted an approach that specifically targets critical windows when social media may particularly impair the completion of essential activities that may affect minors' mental health and wellbeing—sleep and school. Further, randomized trials conducted using direct changes to Facebook and Instagram algorithms showed that switching from personalized feeds to reverse-chronological feeds greatly reduced time spent on social media applications, suggesting this is an appropriate target for policies seeking to reduce children's social media use.

67. Therefore, my professional opinion is that the preponderance of existing evidence to date supports the hypothesis that the provisions in SB 976 will be an effective public health measure that can improve pediatric mental health and wellbeing in California by reducing the amount of time children spend on social media, particularly during critical periods like sleep and school hours.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on December 02, 2024, at Baltimore, Maryland.



Kenneth A. Feder, Ph.D.

EXHIBIT A

CURRICULUM VITAE

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PROFESSIONAL DATA

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EDUCATION AND TRAINING

2019	PhD	Johns Hopkins Bloomberg School of Public Health	Mental Health
2012	BA	Wesleyan University	Physics
2012	BA	Wesleyan University	Psychology

PROFESSIONAL EXPERIENCE

2023-Present Assistant Research Professor
Department of Mental Health
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2021-2023 Assistant Scientist
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Johns Hopkins Bloomberg School of Public Health

2019-2021 Epidemic Intelligence Service (EIS) Officer
Centers for Disease Control and Prevention (CDC)
Assigned to: Maryland Department of Health

2012-2015 Policy Fellow, Connecticut Voices for Children

HONORS AND AWARDS

2024 Bloomberg School of Public Health Student Assembly Advising Mentoring and Teaching Recognition Award
2020 Arc of Montgomery County Annual Public Service Award
2019 *Delta Omega,* inducted
2019 Morton Kramer Fund for the Application of Biostatistics and Epidemiology in Research on the Prevention and Control of Mental Disorders, Department of Mental Health, Johns Hopkins Bloomberg School of Public Health
2017 Paul V. Lemkau Scholarship Fund, Department of Mental Health, Johns Hopkins Bloomberg School of Public Health

2015 Mental Health Scholar Award, Department of Mental Health, Johns Hopkins Bloomberg School of Public Health
2014 Connecticut Health Foundation Health Leadership Fellowship
2012 *Phi Beta Kappa,* inducted

EDITORIAL AND OTHER PEER REVIEW ACTIVITIES

Journal Peer Review Activities

Ad hoc reviewer for: Drug and Alcohol Dependence, JAMA Psychiatry, Journal of Comparative Effectiveness Research, Journal of Medical Internet Research, Journal of Substance Use and Addiction Treatment, Pediatrics, Psychiatry Research, Prevention Science, Psychological Medicine, Substance Abuse, Substance Use and Misuse, Health Affairs

PUBLICATIONS

Journal Articles

Sosnowski DW, Rabinowitz JA, Feder KA, Strickland JC, Hancock DB, Uhl, GR, Ialongo NS, & Maher BS. Polygenic Risk for Substance Use Disorders as Predictors of Substance Use Initiations Among African American Youth. *Journal of Studies on Alcohol and Drugs*. In press.

Feder KA, Li Y, Burke KN, Byrne L, Desai IK, Saloner B, Krawczyk N. Client and Program-Level Factors Associated with Planned Use of Medications for Opioid Use Disorder in Specialty Substance Use Treatment Programs: Evidence from Linked Administrative Data and Survey Data. Journal of Substance Use and Addiction Treatment. In press.

Sonsowski DW, **Feder KA,** Genberg BL, Mehta SH, Kirk GD. Association of Primary Care Engagement with Initiation and Continuation of Medication Treatment for Opioid Use Disorder Among Persons with a History of Injection Drug Use. *Drug and Alcohol Dependence*. 2024 Sep 1;262:111383. https://doi.org/10.1016/j.drugalcdep.2024.111383.

Burke, KN, Krawczyk N, Li Y, Byrne L, Desai IK, Bandara SN, **Feder KA**. Barriers and facilitators to use of buprenorphine in state-licensed specialty substance use treatment programs: A survey of program leadership. *Journal of Substance Use and Addiction Treatment.* 2024 Jul:162:209351. doi: 10.1016/j.josat.2024.209351

Baker P, Cepeda JA, Schluth C, Astemborski J, **Feder KA**, Rudolph J, et al. Time-to-completion of COVID-19 vaccination primary series varies by HIV viral

load status among people who inject drugs in Baltimore, Maryland. *Preventive Medicine Reports*. 2023 Dec 1;36:102448.

Feder KA, Byrne L, Miller SM, Sodder S, Saloner B. Beliefs and Attitudes about Vermont's Buprenorphine Decriminalization Law among Clinicians Who Prescribe Buprenorphine. *Substance Use & Misuse*. 2024 Jan 2;59(1):150–3.

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Feder KA, Krawczyk N, Saloner B. Medication-assisted treatment for adolescents in specialty treatment for opioid use disorder. *Journal of Adolescent Health*. 2017;60(6):747-750. doi:10.1016/j.jadohealth.2016.12.023

Chapters

Shields RT, **Feder KA**. The public health approach to preventing sexual violence. In: Jeglic EL, Calkins C, eds. *Sexual Violence: Evidence Based Policy and Prevention*. Springer International Publishing; 2016:129-144. doi:10.1007/978-3-319-44504-5_9

Articles, Editorials and Other Publications Not Peer Reviewed

Feder KA, Mojtabai R, Stuart EA. Feder et al. Respond to "opioids, economic factors, and misclassification." *American Journal of Epidemiology*. 2020;189(9):898-899. doi:10.1093/aje/kwaa014

Feder KA, Riehm KE, Mojtabai R. Is there an association between social media use and mental health? The timing of confounding measurement matters—reply. *JAMA Psychiatry*. 2020;77(4):438-438. doi:10.1001/jamapsychiatry.2019.4503

Feder KA. Children in the united states opioid epidemic. Published online April 8, 2019. Accessed February 28, 2021. https://dspace-prod.mse.jhu.edu/handle/1774.2/61589

Feder KA, Letourneau EJ, Brook J. Children in the opioid epidemic: addressing the next generation's public health crisis. *Pediatrics*. 2019;143(1). doi:10.1542/peds.2018-1656

Saloner B, **Feder KA**, Krawczyk N. Closing the medication-assisted treatment gap for youth with opioid use disorder. *JAMA Pediatrics*. 2017;171(8):729-731. doi:10.1001/jamapediatrics.2017.1269

PRACTICE ACTIVITIES

Morbidity and Mortality Weekly Report (MMWR)

Feder KA, Pearlowitz M, Goode A, et al. Linked Clusters of SARS-CoV-2 Variant B.1.351 — Maryland, January–February 2021. MMWR Morb Mortal Wkly Rep 2021;70(17):627–31.

Godfred-Cato S, Bryant B, Leung J, Oster ME, Conklin L, Abrams J, Roguski K, Wallace B, Prezzato E, Koumans EH, Lee EH, Geevarughese A, Lash MK, Reilly KH, Pulver WP, Thomas D, **Feder KA**, Hsu KK, Plipat N, Richardson G, Reid H, Lim S, Schmitz A, Pierce T, Hrapcak S, Datta D, Morris SB, Clarke K, Belay E. Covid-19–associated multisystem inflammatory syndrome in children — united states, march–july 2020. MMWR Morb Mortal Wkly Rep. 2020;69(32):1074-1080. doi:10.15585/mmwr.mm6932e2

Practice Related Reports

Feder KA, Byrne L, Miller SM, Sodder S, Berman V, Livingston A, Edwards, J, Hartman S, Harris SJ, Sugarman OK, Shah H, Xu J, Raikes J, Gattine S, Saloner B. Evaluation of a Vermont law eliminating state criminal penalties for possessing 224 milligrams or less of buprenorphine: A report prepared by the Johns Hopkins Evaluation Team of the Bloomberg Overdose Prevention Initiative for Monica Hutt, Chief Prevention Officer, State of Vermont. In press.

Legislative Testimony

Feder KA. Invited testimony regarding H222: An act related to reducing overdoses. Testimony to Vermont House Committee on Human Services. 2023. https://legislature.vermont.gov/committee/document/2024/16/Date/2-22-2023#documents-section

Presentations to Policymakers, Communities, and Other Stakeholders

Desai IK, Krawczyk N, **Feder KA.** Medication assisted treatment in New Jersey Drug Treatment Programs. Presentation to New Jersey Office of the Governor.

Desai IK, Krawczyk N, **Feder KA.** Medication assisted treatment in New Jersey Drug Treatment Programs: a qualitative study. Presentation to New Jersey Division of Mental Health and Addiction Services.

Burke KN, **Feder KA**, Krawczyk N**.** Medication assisted treatment in New Jersey Drug Treatment Programs: a survey study. Presentation to New Jersey Division of Mental Health and Addiction Services.

Feder KA. Evaluation of buprenorphine decriminalization in Vermont. Presentation to Vermont State Epidemiology Outcomes Workgroup. 2022

Feder KA. Evaluation of buprenorphine decriminalization in Vermont. Presentation to substance use treatment providers in Vermont. 2022

Feder KA. Evaluation of buprenorphine decriminalization in Vermont. Presentation to Vermont Chief Prevention Officer. 2022

Feder KA, Ryff KF, Schaar, D, Rao CY. COVID-19 in Hispanic & Latino Communities in Montgomery and Prince George's County Maryland: Preliminary Findings. Briefing following CDC deployment presented for Maryland, Montgomery, and Prince George's County health departments. 2020

Feder KA. Surveillance for Acute Flaccid Paralysis in East Shewa Zone of Oromia Region of Ethiopia. Briefing following CDC deployment to Ethiopia for Global Polio Eradication Initiative (GPEI). 2020

Feder KA. Preventing and Responding to COVID-19 Outbreaks in Group Homes for Persons with Intellectual and Developmental Disabilities. Maryland Department of Health briefing for directors of Maryland disability services providers. 2020

Media Dissemination

Feder KA. Eliminating criminal penalties for buprenorphine may ease overdose crisis. *VT Digger.* 2023; https://vtdigger.org/2023/05/25/kenneth-feder-eliminating-criminal-penalties-for-buprenorphine-may-ease-overdose-crisis/

Feder KA, Krawczyk N. Four facts every journalist should know when covering the opioid epidemic. *Columbia Journalism Review*. 2017; https://www.cjr.org/local_news/opioid-journalist-advice.php.

PART II

TEACHING

Doctoral Advisees

2024-Present Himani Byregowda

Capstone Advisees

2024-2025 Chau Huynh
Master of Public Health

2024-2025 Erin Smith
Master of Public Health

2024-2025 Marissa Gunnarsson
Master of Public Health

2023-2024 Jorden Arbour
Master of Public Health
Thesis: A Scoping Review of Naloxone Distribution from the Emergency Department

2023-2024 Jennifer Harlow
Master of Public Health
Thesis: Hospital-based harm reduction practices for patients with opioid use disorder: a literature review

2023-2024 Iyesatu Barrie-Mason
Master of Public Health
Thesis: Mortality among adults with major depressive disorder: a literature review

2023-2024 Ana Katsafanas
Master of Public Health
Thesis: Mortality among adults who use illicit opioids: a literature review

2023-2024 Mark Lucia
Master of Public Health
Thesis: Association of drug route of administration with self-reported non-fatal overdose before and after the onset of the COVID-19 pandemic

2022-2023 Nicole Fong, MA
Public Health Biology
Thesis: Assessing changes in the emergency department and hospital utilization of people who have injected drugs, from the pre-pandemic period (Jan 1, 2017– Feb 29, 2020) to the COVID-19 pandemic period (Mar 1, 2020–Jan 15, 2023)

2022-2023 Dalya AlJuboori, MHS
Mental Health
Thesis: The factors associated with mental health service initiation among people who have injected drugs with suicidal ideation.

2021-2022 Noah Burton, MHS
Mental Health
Thesis: Serious mental illness affecting substance use treatment dropout and relapse in people who inject drugs

2021-2022 Shereen Sodder, MPH
Thesis: Evaluating the impact of buprenorphine decriminalization in Vermont

Practicum Advisees

2022-2023 Kathryn Burke, MPH
Master of Public Health

External Mentees

2023-2024 Yuzhong Li
NYU School of Global Public Health
Master of Science in Biostatistics
Summer internship co-mentor

Preliminary Oral Exam Participation

2024 Casey Hughes
DrPH, Johns Hopkins Bloomberg School of Public Health
Thesis: Exploring the Influence of Weight Management Hope on Weight-Related Cognitions, Behaviors, and Outcomes Among People with Obesity
Baltimore, Maryland

2024 Michael Ramirez
PhD, Department of Mental Health Oral Exam

Thesis: From Predictors to Prediction: Uncovering Vulnerability to Overdose Mortality Among People Who Inject Drugs in Baltimore, Maryland

2024 Victoria Green
Department of Mental Health
Thesis: Examining the impact of psychiatric rehabilitation programs among adults with serious mental illness in Maryland: A mixed methods study

2023 Justin Rose
Department of Health Policy and Management
Thesis: Local land use policies and geographic access to substance use disorder treatment

Final Oral Exam Participation

2023 Savannah G. Brenneke
Department of Mental Health (Alternate)
Thesis: Applications of traditional epidemiologic and novel infodemiologic approaches to monitoring cannabis and patterns of its use in the us population: Findings from the national household survey on drug use and health (NSDUH) and Reddit

Classroom Instruction

2023 Statistics for Psychosocial Measurement: Measurement Models
330.657.01 (in person)
Department of Mental Health
Johns Hopkins Bloomberg School of Public Health
Instructor

2023 Statistics for Psychosocial Measurement: Measurement Models
330.657.81 (asynchronous online)
Department of Mental Health
Johns Hopkins Bloomberg School of Public Health
Instructor

2018 Psychiatric Epidemiology
Department of Mental Health
Johns Hopkins Bloomberg School of Public Health
Teaching Assistant (Instructors: William Eaton and Heather Volk)

2017 Public Mental Health
Department of Mental Health
Johns Hopkins Bloomberg School of Public Health

Teaching Assistant (Instructor: M. Daniele Fallin)

Guest Lectures

The United States' Shadow Behavioral Health System
Mental Health Services and Systems
Rutgers School of Public Health

RESEARCH GRANT PARTICIPATON

2023- Measuring 40 years of excess mortality among persons with mental and behavioral disorders in Baltimore: A genetically-informed multi-cohort analysis
Johns Hopkins University Discovery Award ($100,000)
Principal Investigator: Kenneth A. Feder

2023- The short- and long-term dynamics of opioid-stimulant use: Mixed methods to inform overdose prevention and treatment related to polysubstance use ($2,158,107)
R01-DA-057673-01
Principal Investigator: Becky Genberg
Role: Co-investigator

2022- Association of non-prescribed use of buprenorphine and methadone with HIV transmission and progression risk behaviors among adults who have injected drugs ($50,000)
Center for AIDS Research
Johns Hopkins University
Principal Investigator: Kenneth A Feder

2021- Primary care engagement, chronic disease risk, and overdose prevention: A multi-decade cohort study ($30,000)
Center for Injury Research and Policy
Johns Hopkins Bloomberg School of Public Health
Principal Investigator: Kenneth A Feder

2021- When pandemics collide: The intersection of the opioid crisis, COVID-19 and HIV pandemics among people who inject drugs in the United States
National Institute on Drug Abuse
R01-DA-053136 ($637,354)
Principal Investigator: Becky Genberg
Role: Co-investigator

2021- Evaluation and Technical Assistance of State Opioid Strategies

Bloomberg Philanthropies ($1,100,000)
Principal Investigator: Joshua Sharfstein
Role: Co-investigator

2017-2019 Collateral consequences of the United States opioid epidemic for children.
National Institute on Drug Abuse
F31 DA044699 ($88,000)
Principal Investigator: Kenneth A Feder

2017-2019 Childhood Adversity in the United States Opioid Epidemic
Doris Duke Foundation
Fellowship for the Promotion of Child Wellbeing ($60,000)
Principal Investigator: Kenneth A Feder

PRESENTATIONS

Scientific Meetings

Desai IK, Burke K, Raikes J, Xu J, Li Y, Saloner B, Bandara S, Feder KA, Krawczyk N. Barriers and Facilitators of MOUD Implementation in Specialty Treatment Programs in New Jersey: A Qualitative Study. College on Problems of Drug Dependence. June 2024.

Moon KJ, **Feder KA**, Kirk GD, Mehta SH, Genberg BL. 1 in 14 prevalence of supplementing methadone or buprenorphine treatment with non-prescribed methadone or buprenorphine in a cohort of people who have injected drugs. College on Problems of Drug Dependence. June 2024.

Bandara S, Ganestsky V, **Feder KA**, Saloner B. (2023) Characterizing implementation of state and hospital policies on plans of safe care and the reporting of "substance exposed newborns" to child welfare agencies. Academy Health Annual Dissemination and Implementation Conference. December 2023.

Baker P, Cepeda J, Schluth C, Astemborski J, **Feder KA**, Rudolph J, Kirk GD, Mehta SH, Genberg BL. HIV viral load and time-to-COVID-19 vaccination among people who inject drugs. Poster presented at the Conference on Retroviruses and Opportunistic Infections, Annual Meeting, Seattle, WA. 2023.

Feder KA. Meeting the Needs of Children Affected by the U.S. Opioid Epidemic. Lecture presented at the Moore Center for the Prevention of Child Sexual Abuse Annual Symposium, Baltimore, MD, 2019.

Feder KA. Children and Families in the Opioid Epidemic. Lecture presented at the American Professional Society on the Abuse of Children Annual Colloquium, New Orleans, LA. 2019

Feder KA, Krawczyk N, Mojtabai R., Crum RM, Kirk GD, Mehta SH. Acquiring Insurance Coverage is Associated with Accessing Substance Use Treatment among People who Inject Drugs. Poster presented at the College on Problems for Drug Dependence Annual Meeting, San Diego, CA. 2018

Feder KA. Descriptive Epidemiology of Families Affected by the United States' Opioid Epidemic. Poster presented at the Moore Center for the Prevention of Child Sexual Abuse Annual Symposium, Johns Hopkins University, Baltimore, MD. 2018

Feder KA. DSM-IV diagnoses associated with perpetrating child maltreatment in a nationally representative sample. Poster presented at the Moore Center for the Prevention of Child Sexual Abuse Annual Symposium, Johns Hopkins University, Baltimore, MD. 2018

Krawczyk N, **Feder KA**. Racial and Ethnic Disparities in Opioid Agonist Treatment for Opioid Use Disorder in a U.S. National Sample. Poster presented at the annual meeting of the College on Problems of Drug Dependence, Montreal, Canada. 2018

Invited Seminars

Feder KA. Protecting children during public health crises: from the opioid epidemic to COVID-19. Public job talk presented to Johns Hopkins Bloomberg School of Public Health, Baltimore, MD. 2021.

Feder KA. COVID-19 in a Network of Group Homes for Adults with Intellectual and Developmental Disabilities – Maryland, 2020. Lecture presented at the EIS presentation series, Atlanta, GA. 2021.

Feder KA, Krawczyk N. Unseen Populations and Unmet Need in the United States Opioid Epidemic. Lecture presented at the Johns Hopkins Bloomberg School of Public Health, Department of Mental Health Weekly Seminar, Baltimore, MD. 2018